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both combined, 204. The price index number for imported cotton goods increased from 100 in 1914-15 to 276 in 1920-21.

Wages show practically a stationary condition, having undergone but a slight change for ten of the principal employments.

The concluding tables of the report have reference to areas cultivated in rice as graded for revenue purposes.

The book is beautifully printed, on good paper, is of convenient size, and is in every respect a most valuable addition to the growing official literature summarizing the results of governmental operations and inquiries. It must ever be a matter of regret that this admirable precedent set by foreign countries should never have been imitated in a similar manner by even a single American state. The progress of any government, in its final analysis, depends primarily upon a clear grasp of governmental facts, and this is impossible without a condensed statement of the vast bulk of statistical information which is now being gathered by practically every civilized country in the world.

The Ministry of Finance of Siam is setting an admirable example for other nations to follow. The publication of the reports in English makes accessible a wealth of information of which much would otherwise go entirely to waste. The *Year Book* is a useful companion volume to the annual report of the Financial Adviser on the Budget of the Kingdom of Siam, whose report for the year 1920-21 has also recently been issued in the English language.

F. L. HOFFMAN

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*United States Life Tables 1890, 1901, 1910, 1901-1910*, prepared by James W. Glover. Published by the Bureau of the Census, Washington. 1921. 496 pp.

This volume, which is divided into eight parts, constitutes a complete report on the mortality tables constructed in connection with the census of 1910. The introduction gives a general description of the entire contents of the report and outlines the purposes in view in presenting the report in the particular form adopted.

Part I consists of a non-technical description and explanation of the life table functions, graphs, and other parts of the book. The plan adopted is to give a fairly complete explanation of the various columns contained in the life tables and of the purposes to which they may be put. This is followed by a very extensive set of questions and answers, covering the same ground much more completely and in a way that will be of assistance to many persons because it shows the exact process by which the answers to certain types of questions may be worked out from the mortality tables.

Part II contains the seventy-four life tables which have been constructed in connection with this census investigation. Sixty-four of these tables may be divided into sixteen sets of four each, each set consisting of a table for male lives in 1901, one for males in 1910, one for females in 1901, and one for females in 1910. Seven of the sixteen sets refer to various sections of the population of the original registration states, one set being for the entire population and the others

for whites, negroes, native whites, foreign-born whites, whites in the cities, and whites in rural districts respectively. Five of the sets refer to the population of the individual states of Indiana, Massachusetts, Michigan, New Jersey, and New York, and the remaining four sets to the individual cities of Boston, Chicago, New York, and Philadelphia. Of the remaining ten tables, two are for both sexes in the original registration states in 1901 and 1910 respectively; six, based on the experience of the ten years from 1901 to 1910 inclusive, refer respectively to white males, white females, negro males, and negro females, all in the original registration states, and to negro males and negro females in the District of Columbia; and two represent the experience in 1890 on males and females respectively in the state of Massachusetts. Twenty-five of these tables, constituting all of those based on the mortality rates in 1910 except those for the individual cities just mentioned, were shown in the preliminary report on the United States Life Tables which appeared in 1916.

These very extensive sets of tables render possible many comparisons of mortality in different classes of the community, in different localities and at different times, the comparison in the latter respect indicating the steady improvement in mortality at the younger ages, with indications of a slight change to increased mortality at the older ages.

The life tables dated 1901 are based on the estimated population July 1, 1901, and on the reported deaths in 1900, 1901, and 1902. Those dated 1910 are based on the estimated population July 1, 1910, and on the reported deaths in 1909, 1910, and 1911. Those for the ten years 1901 to 1910 inclusive are based on the estimated mean population for the period and on the aggregate reported deaths. Those for the state of Massachusetts in 1890 are based on the estimated population December 1, 1889, and on the reported deaths in the census year ending May 31, 1890.

In Part III life tables are shown for twelve foreign countries in comparison with those for whites in the original registration states for the years 1901 to 1910 inclusive. These comparisons are shown for male and female lives respectively and for five different columns of the life table, the important ones of course being the annual rate of mortality per thousand and the complete expectation of life in years. There are also shown ten mortality tables based on life insurance experience, five of these tables being based on experience in the United States and five on experience in foreign countries. These are compared with the life table for white males in the original registration states in 1910.

Part IV consists of graphs of various functions of the more important of the life tables now constructed, and of the various population tables and of the life insurance tables shown in comparison therewith.

Part V consists of tables of annuity values, single net premiums, annual net premiums, and commutation columns based on the life tables for white males and white females respectively in 1910. The life annuity values and commutation columns are given for interest at 3,  $3\frac{1}{2}$ , 4, 5 and 6 per cent, and the net premiums for 3,  $3\frac{1}{2}$  and 4 per cent.

Parts VI and VII are devoted to an explanation of the processes adopted in the construction of the life tables, part VI covering the mathematical theory and

Part VII giving an actual illustration of the processes followed in the construction of one of the tables. The table selected as a sample was one based on male lives in the state of New York in 1910.

Part VIII contains the original data upon which all of the tables were based.

The selection of this volume most open to critical analysis is obviously Part VI, which deals with the principles adopted. In the main section of the table running for the principal tables from age 5 to the neighborhood of age 80, the rates of mortality were derived from redistributed figures for population and for deaths derived according to Mr. King's method based on osculatory interpolation. This does not call for any further comment here except on the point that the particular quinquennial age periods selected were those commencing with ages ending in 4 and 9. It is to be noted that Mr. Papps in his recent paper on this subject expresses a preference for periods beginning with ages ending in 3 and 8, whereas the method adopted by Mr. King for the English Life Table No. 8 agrees with that adopted for the United States Life Tables.

The rates of mortality at the extreme old ages were derived from the application of Wittstein's formula, the constants being determined from rates of mortality at ten consecutive ages derived according to the method proposed by Mr. King to obtain graduated pivotal values for quinquennial interpolations. These rates of mortality are also used to supply preliminary values for a group of ages just below those to which Wittstein's formula is applied. This whole section of the table is finally graduated by Spencer's 21 term formula, and the rates thus arrived at are used to give a gradual transition from those in the middle section of the table to those derived by Wittstein's formula.

The only criticism which I would make of this part of the processes is that the means adopted to weld the two parts of the table together seem to be rather more elaborate than should be necessary. Perhaps, however, they are more complicated in explanation than in actual application.

Possibly the most interesting part of the explanation is that relating to the adjustment of the population at infantile ages. An examination of the population returns by individual ages indicates very clearly a deficiency of population at the two youngest ages, and a comparison with the birth returns indicates that this is not a transfer to other ages but an absolute failure to report. Some method was therefore necessary to estimate the true population at these ages. The method described in this volume may be summarized as an estimate of the population at ages 2 to 5 two years after the close of the period of observation, or three and one-half years after the middle of that period, combined with an analysis of the death returns of the period of observation and the succeeding two calendar years so as to determine, approximately at least, how many of these deaths should be assigned to those born during the three calendar years of observation. It was then assumed that immigration could be ignored at these ages and that the number of births during the period of observation would be obtained by adding these deaths to the estimated survivors two years after the end of the period, their ages being then between 2 and 5 years.

An estimate was then made of the increase in the population at each individual age during the three years, and by successively subtracting from the number of

births these increases and the deaths and making the proper adjustment, the number exposed to risk was obtained for the individual ages. The exposed to risk thus obtained was used for all ages up to four, last birthday inclusive.

It will be noted that these recalculated exposures were used for ages 2, 3, and 4 last birthday, although statistics were available for the population at those ages which were considered as correct, at least in the aggregate, and were used as the basis of the estimate. This suggests a comparison between the average population at these ages as derived from the recalculated exposed risk and the original statistics. This comparison for male lives in the state of New York is shown below, together with other redistributions of the population which will be referred to later.

It will be noted that the total population at these three ages according to the official adjustment is 2,601 less than the total population at the same ages according to the original statistics, which fact indicates an average increase of nearly 1 per cent in the rate of mortality at these ages and suggests the idea that possibly more satisfactory results would have been obtained by sub-

AVERAGE POPULATION

Ages	Original statistics	Official adjustment	First correction	Second correction
2-3.....	94,229	92,372	93,239	93,186
3-4.....	90,718	89,476	90,343	90,454
4-5.....	86,876	87,374	88,241	88,183
	271,823	269,222	271,823	271,823

stituting for the method actually used in estimating the births during the period one based on the idea of so determining these births that after the rest of the process had been followed through, the total of the population at ages 2 to 5 would agree with the original statistics. It is easy to see that this correction would amount to adding 2,601 to the estimated births during the period and consequently to the exposed to risk at each subsequent age. This would amount to adding 867 to the average population at each age and would give the figures contained in the foregoing table under the heading "First correction." This adjustment although probably sufficiently satisfactory for all practical purposes is still liable to the criticism that although the population according to the original statistics for ages 0 to 1 last birthday is deficient, it is used as the basis for the estimate of the increase in population at those ages during the period of observation, and that while we have considered the population of the ages between 2 and 5 as subject to redistribution, varying percentages of increase are used for these ages determined from the original statistics. This objection could be obviated by using a uniform percentage under 5, based on the combined statistics for ages between 2 and 5 and deriving a recurrence formula based on the principle that the increase in population at each age bears a fixed ratio to the finally adjusted population rather than to the original statistics. The figures for the population given in the above table under the heading "Second correction" are derived according

to this method, and the following table gives the rates of mortality at ages 0 to 4 inclusive according to the original statistics unadjusted and according to the various adjustments above referred to.

MALE LIVES IN THE STATE OF NEW YORK  
Rates of Mortality per 1000

Age	Unadjusted	Official	First correction	Second correction
0 . . . . .	135.31	127.13	126.18	126.38
1 . . . . .	37.32	33.64	33.35	33.37
2 . . . . .	15.25	15.56	15.42	15.42
3 . . . . .	9.18	9.31	9.22	9.20
4 . . . . .	6.59	6.55	6.49	6.49

An investigation of the reason for the deficiency in population, disclosed by the official readjustment, indicates that this is principally due to the use of actual death returns for the years 1912 and 1913, which not only did not increase in proportion to the estimated increased population but actually decreased. The actual deaths added in arriving at the assumed births according to the official adjustment were 57,529, and the corresponding deaths during the three years 1909 to 1911 inclusive were 58,926, showing a decrease of 1,397 instead of the expected increase.

The whole volume forms a very valuable addition to our records regarding mortality experience, and it is well worth the study of those interested in the subjects covered by it.

ROBERT HENDERSON

*Introduction to Economic Statistics*, by George R. Davies. New York; The Century Company. 1922. vi, 163 pp.

The economist who would employ quantitative methods in attacking his problems is enabled to do so largely because of contributions made by workers in other fields. Methods of dealing with assembled measurements and with mass phenomena which have been developed by the biometrician, the demographer, the astronomer, the mathematician, the logician, have been taken over by the economist. Though many economists—Jevons, Edgeworth, Moore—have contributed to the development of the science, statistics is to economics an adopted child or, to change the figure, an alien who must be naturalized. The methods of the biometrician cannot be employed unchanged by the economist. Adaptations must be made, new devices employed, and tests made of the validity of old methods when applied to the raw materials of economics. All this is being done. Methods borrowed from Quetelet, Galton, Pearson, and the other fathers of modern statistics are being welded into a body of method designed for handling the data of economics. This by no means involves the building up of a new science of statistics, but merely modification and adaptation, with the central core of the science unchanged.